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First full beta-strength measurement of exotic nuclei with N=125-127 at GSI/FAIR

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Our understanding of the production of the heaviest elements in the Universe is still incomplete. In particular the contribution of the rapid neutron capture (r-) process to the observed abundances of elements with A>180 and the astrophysical site for this process is uncertain. Combining astronomical observations (including gravitational wave detection), nuclear physics laboratory experiments and theoretical modelling we can advance in the solution of the puzzle.

From the point of view of the nuclear data the situation is challenging. In the heavy mass region the abundance distribution peaks at A˜195 (the so-called 3rd peak) which is related to the N=126 shell closure along which the production path runs. There is a lack of experimental information in this remote region, which does not seem easy to fill. Therefore we must rely on theoretical predictions, in particular for the important parameters T1/2 (half-life) and Pn (neutron emission probability). Both parameters are extracted from the calculated beta-strength distribution, which depends on nuclear structure. By now, there exist several theoretical calculations that provide discrepant results for both quantities when crossing N=126 [Mor14,Cab16]. Comparison of the calculated beta strength distributions with measured ones allows to explore the origin of the differences. Total Absorption Gamma-ray Spectroscopy (TAGS) [Rub05] is the only technique able to provide undistorted beta-strength distribution in the full decay energy window.

In June 2022, a experiment was performed at the GSI facility, as part of Phase-0 of FAIR, using the TAGS technique. During the experiment, isotopes of Hg, Au and Pt with N=125-27 were measured. These isotopes were produced by high-energy nuclear reactions with a beam of Pb on Be and selected and identified using the FRagment Separator (FRS) [Win08]. Ion implantations and decay particles were measured with the Advanced Implantation and Decay Array (AIDA) [AIDA], while isometic and β-delayed γ-ray cascades were measured with the Decay Total Absorption Spectrometer (DTAS) [Tai15], both developed within the NUSTAR/DESPEC collaboration. In the poster we will show details about the experiment carried out and preliminary results of the on-line data acquisition.

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